Medulla Oblongata	Respiratory center in brain In normal healthy person, chemoreceptors monitor ∆'s in arterial CO_2 concentrations & that in the CSF ● In COPD pt's the the body works on a hypoxic drive (*chemoreceptors in aortic & carotid bodies*) this is why it's super important to not have this PT @ 100% on pulse ox.
Functions	Provide O_2 for metabolism Remove CO_2 (think acid/base balance)
Circulation	**~5L/minute to lungs** **Bronchial**: blood from the thoracic aorta ~8-9% of CO. returns to circulation via pulmonary vein → slight ↓ in overall O_2 concentration. **Pulmonary:** mean pulmonary pressure (wedge) ~10mmHg ● Normal pressure is LOW and resistance is LOW Pulmonary HTN ● Prolonged ^ in blood flow ○ Left to right shunt ● ^ in resistance ○ Polmonary fibrosis ○ COPD & decreased compliance ○ Hypoxic vasoconstriction (initially a compensatory mechanism, but long term → arteriolar hypertrophy & ^resistance ● Outflow blockage ○ Left heart failure → cor pulmonale ○ Aortic stenosis ○ Mitral regurg
Upper Airway	Nose, Sinus, Pharynx, Larynx, Epiglottis (leaf-shape elastic flap)
Lower Airway	Trachea, Bronchi & bronchioles, Alveoli Alveolar Type 2 cells: produce surfactant which reduces surface tension in the alveoli
Anatomic locations	Base rests on diaphragm Apex above first rib Right has 3 lobes, left has 2 lobes Pleural space contains fluid which prevents friction and maintains integrity between the two pleural surfaces
Ventilation	Air in & out of lungs (~500mL / breath, 15 breaths/min= ~7.5L/minute) Bronchial = high pitched over trachea Bronchovesicular over mainstem bronchi Vesicular in peripheral lungs

Tidal volume	Amount of inspired & expired air per breath (~7.5L minute ventilation)
Dead space	Air in bronchial tree that does not participate in exchange. Around 100-150mL in normally functioning adults
Normals	Rate: 12-20/min Even & symmetric chest expansion No accessory muscle use
Pulse Ox monitoring	<91% = notify Dr <70% = life threatening ------make sure to follow agency policies/procedures------
Incentive Spirometry	Inhale slowly & mark end inspiration point Instruct client to hold breath for 5 seconds and exhale through pursed lips Instruct client to repeat 10x / hr
Oxyhemoglobin dissociation curve	● Why is this important?? ○ affinity of hemoglobin for oxygen. Delivery of O2 to the tissues depends on amount of oxygen that can be picked up in the lungs and how easily the hemoglobin gives up oxygen once it reaches the tissues. Factors which affect how well hemoglobin will bind up oxygen ------ pH (CO_2) ----- Temp -------
Shift to the Left[1]	decreased CO_2 (increased pH) hypothermia (decreased temp), Saturated Hemoglobin wants to hold on to O_2 and not release it to the tissues, so you'll have a high sat but low tissue perfusion. Need more O2 to compensate for decreased oxygen release at the tissue level
Shift to the Right[1]	increased CO_2 (acidosis) hyperthermia (increased temp) Hemoglobin is less saturated with oxygen because it will more readily give it up to the tissues. Tissues still hypoxic because less O_2 bound to the Hgb to release… think quicker decompensation

[1] http://www.ventworld.com/resources/oxydisso/dissoc.html &
https://lifeinthefastlane.com/ccc/oxygen-haemoglobin-dissociation-curve/ &
http://www.rnceus.com/abgs/abgcurve.html

Hypoxemia	**Causes:** Decreased inspired PO_2 (high altitude) Hypoventilation Shunt (intracardiac or atelectasis) -- blood-flow past nonfunctional alveoli V/Q mismatch (Asthma, alveolar disease, vascular disease) Decreased Perfusion: PE, Pulmon Vasoconstriction, ARDS **Assessment:** ● ^RR, Tachycardia ● Confusion, agitation, restlessness **Nursing Plan:** ● Manually ventilate with 100% o2 via BVM if Highflow O_2 doesn't work. Get ready for intubation
<u>Obstructive Diseases</u>[2] COPD / Asthma / Bronchiectasis / Cystic Fibrosis Total Lung Capacity may be normal or increased	
COPD	Persistent obstruction of bronchial out-flow **Assessment:** ● Weakness ● Accessory muscle use / Dyspnea ● Adventitious breath sounds ● ABG Δ's (acidosis) **Nursing Plan:** ● Assess airway clearance & lung sounds & vitals ○ **Exacerbations**: CPAP / BiPAP are Tx of choice. <u>Contraindications</u>: CV or hemodynamic instability, copious secretions. Must allow sufficient expiratory time to avoid auto-PEEP ● Meds ○ Bronchodilators: long acting (salmeterol) w/ ICS ○ Inhaled Corticosteroids (ICS): reduce exacerbations ■ SE: weight gain, osteoporosis, DM ○ Anticholinergics: **ipratropium** ○ Theophylline (Bronchodilator & antiinflam) --- <u>** its use is controversial due to interaction with lots of drugs. Usually reserved for refractory COPD.[3]</u> ● Physiotherapy, Pursed lip breathing, postural drainage, IS **Teaching**: ● SMOKING CESSATION ● Limit risk of infection (get vaccines) ● Conserve energy (don't stand for long periods of time) ● Practice relaxation techniques (yoga, tai chi) ● Eat small frequent meals

[2] http://www.webmd.com/lung/obstructive-and-restrictive-lung-disease#1-3

[3] Lewis, S. M., Barry, M., Goldsworthy, S., & Goodridge, D. (2014). *Medical-surgical nursing: assessment and management of clinical problems*. St Louis, MO: Elsevier.

Asthma[4]	Chronic inflammation → hyperresponse to variety of triggers → airflow obstruction (wheeze) **Assessment:** ● Tachypnea, accessory muscle use & cyanosis = resp distress **Tx**: B_2-ADRENERGICS ● **Albuterol**: short acting B_2 agonist ○ SE: B_1 stimulation in high dose. Monitor K. ● **Salmeterol**: long acting B_2 agonist ○ Dont control inflammation & shouldn't be used without ICS therapy **Theophylline** w/ inhaled corticosteroids for severe asthma.
Bronchiectasis	Irreversible airway dilatation from obstruction or infectious process Commonly caused from H. Influenza **Assessment:** ● Crackles, wheeze, digital clubbing. **Tx:** ● Abx based on sputum/blood sample. ● Hydration
Cystic Fibrosis	Decrease in Cl reabsorption and lack of phenylalanine → thick mucous build up & blockage of glands (mostly pulmonary & GI) ● Neutrophil dominated airway inflammation → edema / scarring Dx: sweat Cl test Tx:
Restrictive Lung Disease Decreased total lung volume, especially Total Lung Capacity (TLC)	
Extrapulmonary [4] **Restrictive diseases** ● CNS ● Chest Wall ● Neuromuscular	**CNS**: Head injury, opioid & barbiturate use **Chest Wall**: Flail chest, fractured rib, Obesity-hypoventilation syndrome (pickwickian syndrome), **Neuromuscular**: Spinal cord injury, Guillain-Barre syndrome, ALS, myasthenia gravis, muscular dystrophy.
Intrapulmonary [4] **Restrictive Disease** ● Pleural Disorders ● Parenchymal Disorders	**Pleural Disorders**: pleural effusion, pleurisy, pneumothorax **Parenchymal**: Atelectasis, pneumonia, interstitial lung disease, ARDS, TB
Pleural Effusion[5]	Excess fluid in the pleural space and/or failure of removal by pleural lymph **Transudative**: caused by systemic infection

[4] Harrisons Manual of Medicine, 18th ed.
[5] Harrisons Manual of Medicine, 18th ed.

	● Causes: LVHF, Cirrhosis, Nephrotic syndrome **Exudative**: local infection ● Causes: Bacterial pneumonia, viral infection, PE
Atelectasis	**Compression:** outside pressure source → collapse (pneumothorax, tumor, abdominal distention, edema & interstitial edema) **Absorption:** blockage → air diffusion & collapse (CF, pneumonia, anesthesia) ● prolonged bedrest → pooling of secretions in dependent areas & ^risk of pneumonia ● Anything that causes a reduction of surfactant will → collapse ○ Like premature birth, near drowning (dilute surfactant). Damage to type II alveolar cells
Pleural Disorders Pneumo	**Assessment:** ● Chest pain, SOB ● Decreased breath sounds ● Agitation **Spontaneous Pneumo:** rupture of small blebs (air-filled blisters) which can occur in young healthy individuals (primary) or as a result of some type of lung disease (COPD, Asthma, Pneumonia, Cystic Fibrosis) **Traumatic Pneumo / Tension Pneumo** **Tx:** ● Chest tube 2ICS MCL for pneumo to suction of 20cm h2o ● Chest tube 5ICS AAL for hemothorax ● **NEVER CLAMP THE TUBE!!!!** ● Adult size: 28-36 fr. ------ child: 18-24fr.------
Chest Tube	**Nursing Plan**: ● Pre insertion: IV access, ambu bag, consider intubation supplies ● Insertion: HD stable = analgesia ○ Position pt affected side up & elevate HOB 20-30* ○ MD creates incision and inserts & sutures tube in place ● **MONITOR:** vasovagal response (↓HR, ↓BP, ↓LOC) ○ Wall suction should be set between 80 - 120 … but check with facility protocol **REMOVAL:** <200mL output in 24h ● No air leak ● Premedicate (usually morphine 4mg IV) ● Clamp CT, remove dressing & suture ● Ask patient to valsalva (BEAR DOWN THE WHOLE TIME) (pull @ end-inspiration if vented) ● Apply vaseline gauze dressing & order CXR **Pt Teaching:** Encourage client to Δ positions frequently

	Drainage must be below insertion level at all times On removal, instruct PT to ● Constant bubbling = leak in system ○ Gentle bubble on insertion is expected. Air leaving pleural space ● If dislodged, apply pressure over insertion site w/ a gloved hand ● If disconnected, put in sterile water until a new system is set up
Pneumonia	**Assessment:** ● Fever ● Leukocytosis ● Productive cough **Nursing plan:** ● Assess breath sounds & o2 sat ● TCDB q2h ● Assess vitals q4h ● Admin ABX per orders ● Suction as needed
Acute **R**espiratory **D**istress **S**yndrome	is a manifestation of acute injury to the lung, commonly resulting from sepsis, trauma, and severe pulmonary infections. Clinically, it is characterized by dyspnea, profound hypoxemia, decreased lung compliance, and diffuse bilateral infiltrates on chest radiography[6] ● NONcardiac Pulmonary edema ○ Excessive alveolar membrane permeability ○ Interstitial edema ○ Diffuse alveolar injury ○ Disruption of macrophage function ○ ^risk for infection
ARDS Classification	Development of acute dyspnea & hypoxemia w/in 12-48hrs of inciting event. PaO_2 / FiO_2 with ≥ 5cm H_2O PEEP **Mild**: 201-300 **Moderate**: 101-200 ---- Proning ≥10hrs significantly ↓ mortality **Severe**: <100
Phases of ARDS	○ **Exudative**: w/in 72hrs of injury. Rapid RR & WOB. O2 near normal levels ○ **Fibroproliferative**: II alveolar cell destruction → ↓surfactant production. Tachypnea & ↓$PaCO_2$. ○ **Resolution:** weeks - months. Oxygenation improves. Chest xray clears. Compliance increases & peak airway pressure decreases
ARDS intubation	Vt: 4-6mL / kg = lung protection. Maintain pH ≥7.2 w/ IV bicarb

[6] http://www.aafp.org/afp/2003/0115/p315.html

protocol	● Acidosis → dissociation of o2 & improved oxygenation Ventilation modes that reduce barotrauma ● Pressure-regulated Volume Control (PRVC) ● Airway Pressure release Ventilation (APRV) ● Pressure-controlled Inverse Ratio (PC-IRV) ● High frequency oscillatory ventilation (HFOV) Maintain SpO_2 >90% A-Line for frequent ABG & Pressure assessment Early Neuromuscular blockade (w/in 48hrs) w/ Prone positioning (12-16hrs/day) improves outcomes & reduces mortality
Tuberculosis	Lower resp infection (mycobacterium tuberculosis) -- DROPLETS Macrophages engulf the bacilli & T-cells form fibrous tissue around called a **Tubercle**. **S&S**: fever, SOB, Night sweats w/ productive cough. ● QuantiFERON-TB test ● Active TB dx by sputum sample Tx: Rifampin, Isoniazid, Pyrazinamide … Ethambutol ● Vitamin B6 (pyridoxine) is given w/ isoniazid as neuroprotectant
Pulmonary Embolism	Chest pain, cough, dyspnea w/ tachycardia. ● D-Dimer <500µg/mL used to RO a PE **Tx:** unfractionated heparin 80 units/kg loading dose IV, followed by 18 units/kg/hour IV infusion, adjusted according to APTT ● Warfarin for long term suppression ● Inferior Vena Cava Filter for refractory emboli
Total Laryngectomy	**Assessment**: ● Monitor airway for obstruction **Nursing Plan**: ● Will need laryngectomy tube to prevent scar contracture ● Will not be able to sing, laugh, whistle w/ post procedure ● May have difficulty w/ taste & smell ● Teaching for esophageal speech: swallow & eructate air
Benefits of Tracheostomy	Patient comfort Improved ability to communicate Ability to eat and drink ● Cuff pressure should be <25cmH_2O
Indications for Intubation	Anesthesia during surgery Inability to protect airway ALOC Anticipated airway obstruction ● Facial burns, epiglottitis, major oral/facial trauma Apnea

	● PaO2 <60mmHg ^Risk of Aspiration Planned postprocedural short-term ventilation
Volume Ventilation	Delivers gas @ preset Vt & Minute volume (volume x rate) ● **Continuous Mandatory Ventilation**: vent controls all breaths. REQUIRES SEDATION & NEUROMUSCULAR BLOCKS ● **Assist Control**: supports every inspiratory effort with total set Vt ● **SIMV**: set # of breaths @ set Vt. Pt takes breaths but are not assisted with Vt (patient's own spontaneous Vt)
Pressure Ventilation	Delivers gas @ preset pressure limit. Variable Vt & minute vol. ● **Pressure-Controlled**: set # of breaths w/ limit on pressure applied. Require sedation & possibly neuromuscular block ● **Pressure Support**: set amount of inspiratory pressure for spontaneous breaths. COMPLETELY PATIENT CONTROLLED ○ For WEAN ○ Adjunct to SIMV for non-Vt supported breaths ● **PEEP**: prevent atelectasis. Improve oxygenation & lung volume. MOST COMMON BETWEEN 5-15cmH_2O
Spontaneous Awakening Trial **safety screen**	Done q24h. Questions to determine spontaneous breathing trial ● ICP w/in normal limits ● No seizure activity ● No agitation ● No neuromuscular block ● No active MI IF FAILS DAILY SAT --- START SEDATION @ ½ previous dose
SBT failure	SpO_2 <88% ---------- acute dysrhythmia Resp distress or ALOC ------- RR >35 or < 8 / minute
Neuromuscular Blocks	**----- Vecuronium --- or ----Cisatracurium---** Train of 4: assesses level of blockade BIS: sedation assessment monitoring system ● <40 = anesthesia or burst suppression for status epilept. ● 40-60 = ideal # when neuromuscular is used
CV complications of Intubation	PPV = ^IntraThoracic Pressure & ↓ preload & CO → ischemia
Ventilator-associated pneumonia	~21.8% of intubated pt's